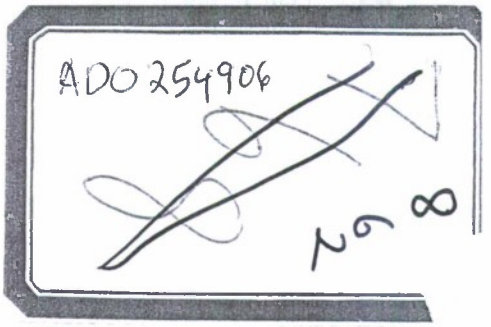

WADD TECHNICAL REPORT 60-809

DEVELOPMENT OF AN EMERGENCY PRESSURE SUIT COVERALL, HIGH ALTITUDE, VENTILATION-EXPOSURE TYPE CSU-5/P

David Clark Company Incorporated

NOVEMBER 1960

WRIGHT AIR DEVELOPMENT DIVISION

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David Clark Company Incorporated

NOVEMBER 1960

Operational Support Engineering Division
Contract No. AF 33(600)-36627
Project No. 6336
Task No. 63619

WRIGHT AIR DEVELOPMENT DIVISION
AIR RESEARCH AND DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

900 — March 1961 — 23-901

F O R E W O R D

This report was prepared by the David Clark Company Incorporated, Worcester, Massachusetts, on Air Force Contract AF 33(600)-36627, under Task No. 63619 of Project No. 6336, "Development of an Emergency Pressure Suit Coverall, High Altitude, Ventilation-Exposure, Type CSU-5/P." The work was administered under the direction of Operational Support Engineering Division, Wright Air Development Division. Mr. Kent W. Gillespie was task engineer for the Laboratory.

The studies presented began in February 1958, were concluded in November 1960 and represent a joint effort of the analysis and evaluation group at the Laboratory and the Development Group of the David Clark Company Incorporated. Research Director, Joseph A. Ruseckas, was the engineer responsible for research activity of the David Clark Company Incorporated.

Although the studies were a group effort, the chief contributors and their fields of endeavor were: A. J. Kenneway, Project Director; Richard T. Sears, design and development; Richard Murdock, photography; and Hazel E. Cutting, editing and preparation of copy for reproduction.

The report concludes the work on Contract AF 33(600)-36627.

A B S T R A C T

This report describes the various features evaluated during the development of Coveralls, Flying, High Altitude, Ventilation-Exposure, Type CSU-5/P. Each progressively improved prototype garment is described and results are reported. Practical solutions were achieved in some areas, but additional work is required in others.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:

W. P. Shepardson
Chief, Crew Equipment Branch
Operational Support Division

SUMMARY

Developmental prototypes of emergency pressure suit, Type CSU-5/P, are described. Subsequent sizing of this coverall in the eight-size height-weight program was based on the fourth model, Figures 11 and 12.

The development of this coverall presents an opportunity to consolidate the anti-exposure and altitude coveralls with a minimum penalty for weight, when used on a specific mission profile which requires protection at altitude, and exposure on land and water in cold climates.

A review of the attempts to integrate the neck seal bladder and coverall, in conjunction with quick entry methods, indicates definite progress, but requires that modifications be considered.

C O N T E N T S

I L L U S T R A T I O N S

I. INTRODUCTION

The development and subsequent standardization of the Type CSU-4/P high altitude coverall provided a garment with adequate physiological protection up to 70,000 feet, with long-term capabilities, and at the same time furnished comfort, mobility and ease of donning. The CSU-4/P coverall was not initially designed with a ventilation provision, but this feature was later incorporated. While not intentionally designed as such, the CSU-4/P does provide some exposure protection, due to its inherent design. The CSU-4/P and CSU-5/P coveralls have the same altitude capability with equal growth potential regarding time and altitude.

This report deals with the development of the CSU-5/P coverall which was designed to specifically provide exposure protection in addition to the features already included in the CSU-4/P coverall.

II. PROGRESSIVE DEVELOPMENT OF THE CSU-5/P HIGH ALTITUDE COVERALL

The final version of the coverall, flying, high altitude, ventilation-exposure, Type CSU-5/P, David Clark Company P/N S-848D, fabricated on this contract, was developed through five progressively improved models.

A. FIRST MODEL

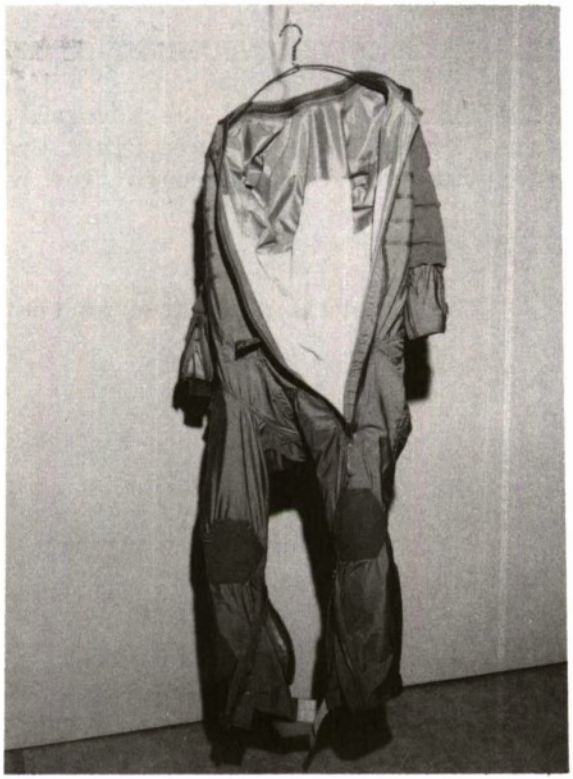
The coverall submitted as the first model, P/N S-848, Size Medium Regular

Figure No. 1 First Model, P/N S-848

Manuscript released for publication as a WADD Technical Report on 18 November 1960.

(Figure 1), was based on the Type CSU-4/P high altitude coverall and sized to the eight-size height-weight sizing program. This coverall designated Type CSU-5/P, included ventilation and exposure features. The outer bladder served as the anti-exposure coverall layer. Wrist seals and wrap-around ankle seals were incorporated as an integral part of the garment. The boots would be worn as a separate piece of equipment (Figure 2). A Goodrich pressure sealing slide fastener extending from the left lower thigh to the collar was used to seal the entry opening, while the leg slide fasteners extended from ankle to knee area for leg closure (Figure 3). The ventilation garment was integrated with the inner layer of the altitude bladder, covering the chest, back and thigh areas. The purpose in making an integral ventilation garment was to eliminate the need for a separate vent garment and a watertight aperature for the service hose of the vent garment.

First Model, P/N S-848
Wrist and Ankle Seals
Figure 2

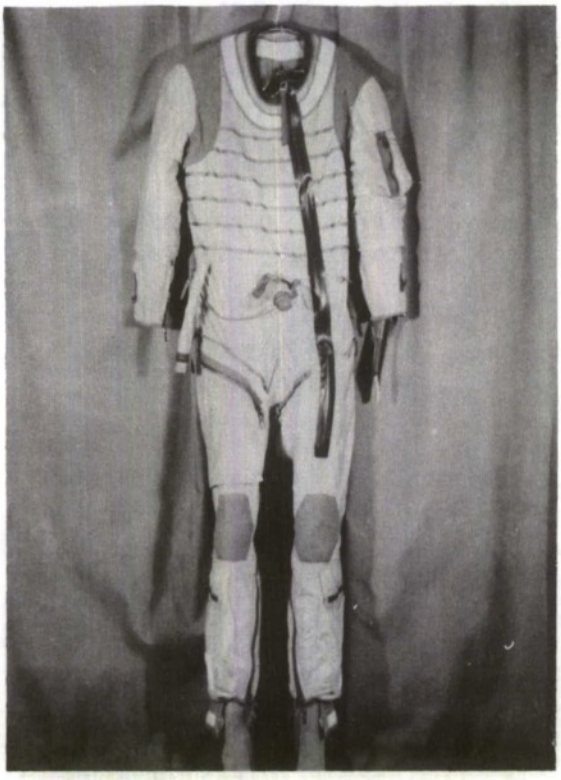


First Model, P/N S-848
Closures
Figure 3

B. SECOND MODEL

The second model, P/N S-848A, Size Medium Regular (Figure 4), was an improved version of the preliminary model. In order to improve watertightness, plackets on leg and wrist closures were installed, the ankle seal was improved and a roll seal arrangement was incorporated at the collar section (Figure 5). Velcro pile tape, to serve as an anchor for the helmet bladder, was installed on the inside at the neck area, in place of the anti-skid pad used on the

previous coverall (Figure 6). The pile tape was used in preference to the hook tape because of the high abrasive characteristics of the hook tape. A BDM slide fastener, modified to include the pull tab on the under side of the slider, in conjunction with a standard medium heavy slide fastener, was used on the entry in lieu of the Goodrich pressure sealing slide fastener which was difficult to close and caused pressure points when the wearer assumed a sitting position. Several changes were made in the ventilation layer. The number of vent holes was reduced to clusters of three rather than the four used in the first model, resulting in greater force behind the air flow. The ventilation air inlet was moved to a location similar to that in the MA-3 ventilation garment. The air flow resistance was reduced to 2 or 3 inches H_2O at a flow of 10 CFM. The sharp bend in the hose was eliminated and Trilok (U. S. Rubber Style No. 6006-1-1) to serve as a spacer was added between the pressure bladder and ventilation layer. Ventilation exhaust valves were installed in each extremity as in the MD-1 exposure suit. Because this valve would be between the subject and the pressurized bladder layer when the suit was inflated, it was necessary to develop a flatter valve.



Second Model, P/N S-848A
Figure 4

Second Model, P/N S-848A
Watertight Features
Figure 5

Second Model, P/N S-848A
Helmet Bladder with Velcro Features
Figure 6

The lower leg openings were redesigned to allow for easier donning and doffing. Pockets, the same as in the MD-1 coverall, were provided, arranged as in the K-2B coverall.

To allow for the additional spacer material, the coverall was enlarged in circumference by one inch at the waist, hips and thighs, tapering to one-half inch on the lower legs.

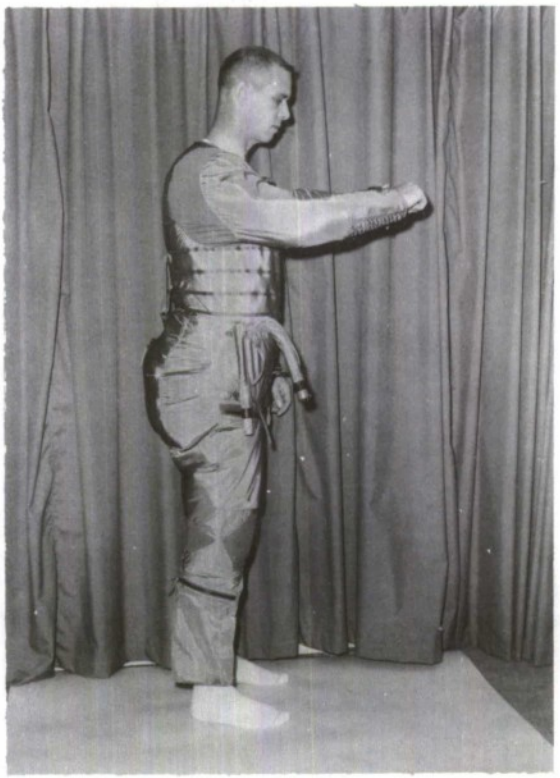
A protective covering of helanca was provided over the link-net sections at the arm scye area.

C. THIRD MODEL

Evaluation of the watertight features of the second model indicated the desirability of a change in design based on the "wet suit" principle, to make a water barrier CSU-5/P coverall which permits elimination of undesirable features such as the watertight entry slide fastener and the neck, wrist and ankle seals. The third model (Figure 7) incorporates a standard entry slide fastener in place of the watertight fastener and the neck, wrist and ankle seals were eliminated (Figure 8). The ventilation layer air inlet and hose were relocated in line horizontally with the suit bladder oxygen inlet hose and toward the front, making the center line distance between vent hose and bladder about 3.5 inches, thus making the coverall more compatible with a greater variety of articles of aircrew personal equipment (Figure 9). Insulation was incorporated inside the suit bladder using two layers of Trilok (U. S. Rubber Style

Third Model, P/N S-848B, Front View
Figure 7

Third Model, P/N S-848B
Water Barrier Concept, Figure 8



Third Model, P/N S-848B, Side View
Figure 9

Third Model, P/N S-848B
Relief Provision, Figure 10

No. 6009-1-140). The inner layer covered the same area except for underarm, crotch and back of knees. To prevent shifting during donning and doffing, the insulation layers were tacked in place. A provision was included to provide for relief without doffing the coverall (Figure 10).

An automatic sealing feature to prevent entry of water when bladder hose is disconnected was included in the bladder inlet connection. No ventilation air exhaust valves were installed.

D. FOURTH MODEL

This model, Size Large Long, P/N S-848C, included a single layer of Trilok for insulation inside the suit bladder in place of the double layer in the previous model and covered the same body area except underarm, crotch, back of knees and cubital space of the elbow (Figures 11, 12). Tests on the third model submitted had established the fact that there was not sufficient increase in clo value to warrant the bulk of the double layer.

Larger slide fastener openings were provided in the lower leg pockets to facilitate insertion and removal of hands. Rust and corrosion proof eyelets were installed at each lower corner of all pockets to allow for water drainage from inside the pockets when the suit is removed from the water (Figure 13).

Fourth Model, P/N S-848C
Front View
Figure 11

Fourth Model, P/N S-848C
Back View
Figure 12

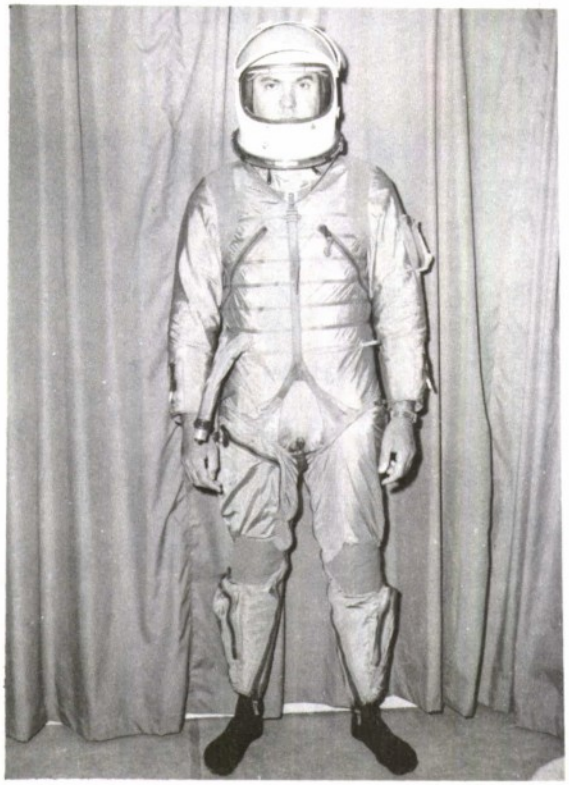
The sizing label included the height-weight range in addition to the size, facilitating the proper selection of the appropriate size coverall (Figure 14).

Fourth Model, P/N S-848C
Pocket Arrangement
Figure 13

Fourth Model, P/N S-848C
Labels
Figure 14

E. FIFTH MODEL

The fifth model, incorporating a new concept of entry and donning, was fabricated in size Medium Regular and designated P/N S-848D. It featured a circumferential entry slide fastener and tie-down assembly as on the A/P-22S-2 full pressure suit instead of the vertical front entry slide fastener (Figure 15). The neck collar portion of the coverall (Figure 16) was enlarged in order to attach the neck seal bladder and ring disconnect, P/N ACS-257 (Figure 17), to provide for simultaneous donning of the assembly. Provisions were made for the removal of the neck seal and ring disconnect in the event replacement is required (Figure 18). The ventilation system is an adaptation of the system used in the A/P-22S-2 full pressure suit, incorporated within the walls of the breathing bladder and dumping at the extremities. It also includes a nylon liner, similar to that in the full pressure suit ventilation system.



Fifth Model, P/N S-848D
Figure 15

Fifth Model, P/N S-848D
Neck Collar Portion
Figure 16

F. SIZING PROGRAM

Coveralls, sized in accordance with the eight-size height-weight sizing program, Small Regular, Small Long, Medium Regular, Medium Long, Large Regular, Large Long, Extra Large Regular and Extra Large Long, were fabricated in the same basic design as the fourth model (Figures 11 and 12), with a few minor modifications, such as pockets similar to A/P-22S-2 suit, leather and cord pull tabs, bleed adapter and adapter pocket for bleeding the trapped air in the bladder section to facilitate donning (Figure 19).

Fifth Model, P/N S-848D
Neck Seal Bladder and Ring Disconnect
Figure 17

Replacement Features
Neck Seal Bladder
Figure 18

Additional Modifications
Figure 19